



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2026 – 05:04 PM UTC

PDB ID : 1B9F / pdb_00001b9f
Title : MOBILITY OF AN HIV-1 INTEGRASE ACTIVE SITE LOOP IS CORRELATED WITH CATALYTIC ACTIVITY
Authors : Greenwald, J.; Le, V.; Butler, S.L.; Bushman, F.D.; Choe, S.
Deposited on : 1999-02-11
Resolution : 1.70 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at validation@mail.wwpdb.org

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

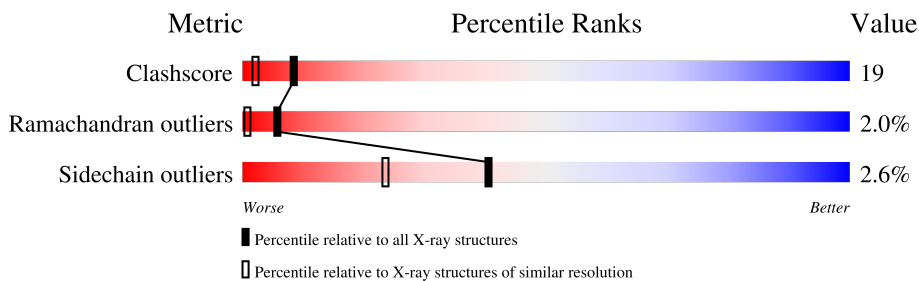
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.70 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
Clashscore	190562	5924 (1.70-1.70)
Ramachandran outliers	187476	5846 (1.70-1.70)
Sidechain outliers	187428	5846 (1.70-1.70)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	163	

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 1236 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

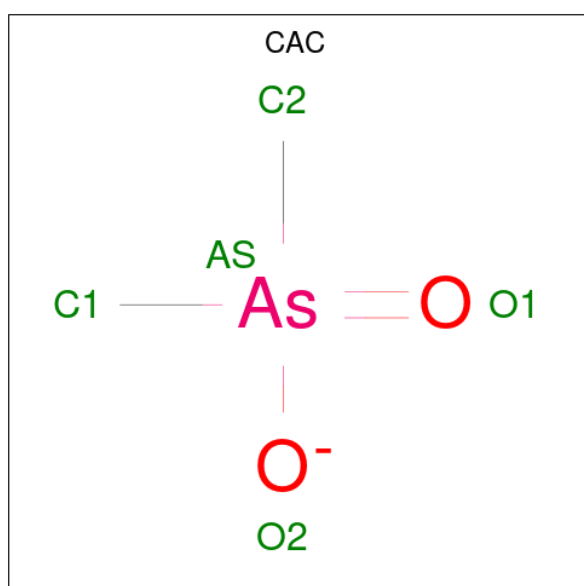
- Molecule 1 is a protein called PROTEIN (INTEGRASE).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	151	Total	C	N	O	S	0	3	0
			1154	735	202	212	5			

There are 3 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	140	ALA	GLY	engineered mutation	UNP P12497
A	149	ALA	GLY	engineered mutation	UNP P12497
A	185	LYS	PHE	engineered mutation	UNP P12497

- Molecule 2 is CACODYLATE ION (CCD ID: CAC) (formula: $C_2H_6AsO_2$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	As	C	O	0	0
			4	1	2	1		
2	A	1	Total	As	C	O	0	0
			4	1	2	1		

- Molecule 3 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	O	S	0	0
			5	4	1		

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	69	Total	O	0	0
			69	69		

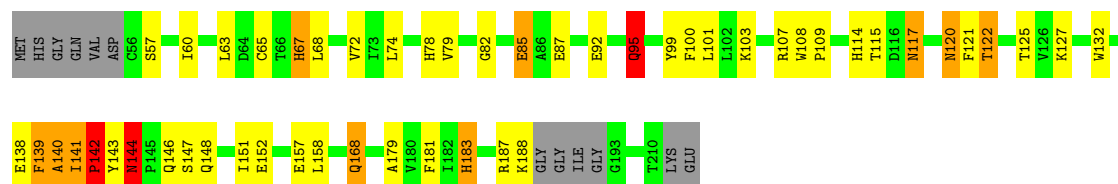
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

Note EDS was not executed.

• Molecule 1: PROTEIN (INTEGRASE)

Chain A: 



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, α , β , γ	72.44Å 72.44Å 65.42Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	20.00 – 1.70	Depositor
% Data completeness (in resolution range)	95.3 (20.00-1.70)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	0.05	Depositor
Refinement program	REFMAC	Depositor
R, R_{free}	0.243 , 0.280	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	1236	wwPDB-VP
Average B, all atoms (Å ²)	35.0	wwPDB-VP

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: CAC, SO4

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	$\# Z > 5$	RMSZ	$\# Z > 5$
1	A	1.03	1/1188 (0.1%)	1.99	42/1613 (2.6%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	115	THR	CA-C	5.03	1.58	1.52

All (42) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	115	THR	O-C-N	9.71	134.93	123.17
1	A	120	ASN	CA-CB-CG	9.68	122.28	112.60
1	A	122	THR	N-CA-C	8.58	120.71	111.36
1	A	117	ASN	OD1-CG-ND2	-8.07	114.53	122.60
1	A	115	THR	CA-C-O	-7.90	112.47	121.40
1	A	127	LYS	O-C-N	7.12	129.67	122.12
1	A	68	LEU	O-C-N	-7.04	115.39	123.42
1	A	79	VAL	N-CA-C	6.95	117.09	110.42
1	A	139	PHE	CA-CB-CG	-6.93	106.87	113.80
1	A	179	ALA	O-C-N	-6.85	114.86	122.12
1	A	142	PRO	N-CA-CB	6.76	110.35	103.25
1	A	181	PHE	CA-CB-CG	6.74	120.54	113.80
1	A	181	PHE	O-C-N	6.36	128.62	122.07
1	A	101	LEU	O-C-N	6.25	128.75	122.12
1	A	108	TRP	CA-C-O	-6.24	114.47	120.64
1	A	132	TRP	CA-C-O	6.08	127.20	120.82
1	A	115	THR	CA-C-N	-6.00	113.05	122.65
1	A	115	THR	C-N-CA	-6.00	113.05	122.65
1	A	121	PHE	CA-CB-CG	5.92	119.72	113.80
1	A	168	GLN	CB-CG-CD	5.90	122.63	112.60

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	132	TRP	O-C-N	-5.82	116.08	122.07
1	A	139	PHE	N-CA-C	5.82	117.69	108.67
1	A	144	ASN	CA-CB-CG	5.78	118.38	112.60
1	A	151	ILE	N-CA-C	5.55	116.28	110.62
1	A	78	HIS	O-C-N	5.54	130.02	122.82
1	A	95	GLN	OE1-CD-NE2	-5.53	117.08	122.60
1	A	95	GLN	CB-CG-CD	5.41	121.80	112.60
1	A	122	THR	CA-CB-CG2	5.39	119.66	110.50
1	A	87	GLU	CA-C-N	-5.34	116.17	123.12
1	A	87	GLU	C-N-CA	-5.34	116.17	123.12
1	A	67	HIS	CA-CB-CG	-5.30	108.50	113.80
1	A	85	GLU	CA-C-O	-5.29	114.58	120.66
1	A	99	TYR	CA-C-O	5.19	125.92	120.42
1	A	183	HIS	O-C-N	-5.19	116.69	122.09
1	A	183	HIS	CA-CB-CG	-5.16	108.64	113.80
1	A	158	LEU	O-C-N	-5.12	116.80	122.07
1	A	101	LEU	CA-C-N	-5.05	113.11	120.29
1	A	101	LEU	C-N-CA	-5.05	113.11	120.29
1	A	65	CYS	O-C-N	5.05	129.80	123.23
1	A	109	PRO	O-C-N	5.04	129.44	122.64
1	A	183	HIS	CB-CG-CD2	-5.03	124.66	131.20
1	A	187	ARG	NE-CZ-NH2	5.03	123.73	119.20

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts ⓘ

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	1154	0	1129	40	0
2	A	8	0	0	4	0
3	A	5	0	0	0	0
4	A	69	0	0	2	0
All	All	1236	0	1129	44	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including

hydrogen atoms). The all-atom clashscore for this structure is 19.

All (44) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:A:300:CAC:AS	2:A:300:CAC:C1	2.20	1.50
2:A:400:CAC:AS	2:A:400:CAC:C1	2.22	1.47
2:A:400:CAC:AS	2:A:400:CAC:C2	2.26	1.44
2:A:300:CAC:AS	2:A:300:CAC:C2	2.29	1.40
1:A:63:LEU:HD11	1:A:74:LEU:HD21	1.21	1.13
1:A:60:ILE:HG21	1:A:138[A]:GLU:OE1	1.72	0.88
1:A:63:LEU:HD11	1:A:74:LEU:CD2	2.07	0.84
1:A:144:ASN:ND2	1:A:147:SER:H	1.76	0.81
1:A:60:ILE:CG2	1:A:138[A]:GLU:OE1	2.30	0.78
1:A:85:GLU:OE1	1:A:107[B]:ARG:NH2	2.20	0.73
1:A:85:GLU:CD	1:A:107[B]:ARG:HH22	2.01	0.69
1:A:125:THR:HG23	4:A:423:HOH:O	1.94	0.67
1:A:144:ASN:HD22	1:A:147:SER:H	1.45	0.65
1:A:82:GLY:O	1:A:183:HIS:HE1	1.85	0.58
1:A:139:PHE:O	1:A:140:ALA:C	2.49	0.56
1:A:144:ASN:HD22	1:A:144:ASN:C	2.13	0.56
1:A:95:GLN:H	1:A:95:GLN:NE2	2.07	0.53
1:A:148:GLN:O	1:A:152:GLU:HG3	2.07	0.53
1:A:157:GLU:OE1	1:A:188:LYS:NZ	2.41	0.53
1:A:74:LEU:C	1:A:74:LEU:HD23	2.33	0.53
1:A:74:LEU:HD22	1:A:100:PHE:CE2	2.44	0.52
1:A:142:PRO:O	1:A:143:TYR:C	2.53	0.52
1:A:74:LEU:HD22	1:A:100:PHE:CD2	2.46	0.51
1:A:114:HIS:NE2	1:A:140:ALA:HA	2.25	0.51
1:A:140:ALA:O	1:A:141:ILE:C	2.53	0.51
1:A:72:VAL:HG11	1:A:92:GLU:HG3	1.92	0.50
1:A:144:ASN:ND2	1:A:146:GLN:N	2.59	0.49
1:A:168:GLN:HG2	4:A:435:HOH:O	2.11	0.49
1:A:117:ASN:HD22	1:A:117:ASN:C	2.22	0.48
1:A:144:ASN:ND2	1:A:146:GLN:H	2.12	0.48
1:A:57:SER:HB3	1:A:60:ILE:CD1	2.43	0.47
1:A:117:ASN:O	1:A:120:ASN:HB2	2.15	0.46
1:A:60:ILE:HG23	1:A:138[A]:GLU:OE1	2.11	0.46
1:A:144:ASN:ND2	1:A:144:ASN:C	2.74	0.45
1:A:107[A]:ARG:HH11	1:A:107[A]:ARG:HG3	1.82	0.44
1:A:144:ASN:HD22	1:A:146:GLN:N	2.16	0.44
1:A:85:GLU:CD	1:A:107[B]:ARG:NH2	2.71	0.44
1:A:143:TYR:O	1:A:144:ASN:C	2.61	0.43

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:95:GLN:H	1:A:95:GLN:HE21	1.66	0.43
1:A:157:GLU:OE2	1:A:183:HIS:HD2	2.02	0.43
1:A:85:GLU:OE2	1:A:107[B]:ARG:NH1	2.52	0.42
1:A:157:GLU:CD	1:A:183:HIS:HD2	2.28	0.41
1:A:67:HIS:NE2	1:A:92:GLU:OE1	2.51	0.40
1:A:103:LYS:O	1:A:107[B]:ARG:HD3	2.21	0.40

There are no symmetry-related clashes.

5.3 Torsion angles [i](#)

5.3.1 Protein backbone [i](#)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
1	A	150/163 (92%)	144 (96%)	3 (2%)	3 (2%)	6 1

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	142	PRO
1	A	140	ALA
1	A	141	ILE

5.3.2 Protein sidechains [i](#)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
1	A	118/133 (89%)	115 (98%)	3 (2%)	42 24

All (3) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	95	GLN
1	A	122	THR
1	A	144	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	95	GLN
1	A	117	ASN
1	A	120	ASN
1	A	144	ASN
1	A	183	HIS

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

3 ligands are modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the

expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
2	CAC	A	400	1	0,3,4	-	-	0,3,6	-	-
3	SO4	A	1	-	4,4,4	0.68	0	6,6,6	0.09	0
2	CAC	A	300	1	0,3,4	-	-	0,3,6	-	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	400	CAC	2	0
2	A	300	CAC	2	0

5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

6 Fit of model and data

6.1 Protein, DNA and RNA chains

EDS was not executed - this section is therefore empty.

6.2 Non-standard residues in protein, DNA, RNA chains

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.